

Sampling Soil Arthropods at Mountain Lake Biological Station, Virginia, Over a 32-Year Period¹

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For the past 32 years, the first laboratory-field exercise in my basic entomology course (Biology of Insects) has involved collecting a small soil sample and extracting from it the animals (micro-fauna) that can be retrieved by use of a Berlese funnel. This course has been offered 16 times, essentially in alternate summers, at Mountain Lake Biological Station of the University of Virginia, 1.6 km north of Mountain Lake, in Giles County, Virginia. Each time but the first, in 1961, the results of our census of recovered animals were recorded and retained, a copy having been given to each member of the class.

Each sample was one square foot of soil one inch deep (approximately 30.5 x 30.5 x 2.5 cm., or 2326 cc.), together with any covering leaf-litter. Samples were biased in some ways: we avoided large tree roots and sought places where low herbaceous plants would be minimally damaged; we also avoided sampling beneath coniferous trees because of the effects of resins on soil fauna. Some ecological factors, such as soil temperature at one-inch depth compared to air temperature, were in each case recorded. (The average difference, over the years, was 4.5°C, with the actual soil temperatures varying according to the season and the weather of the year, from 12.8 to 18.9°C, with a mean of 17.1°C.)

All samples were taken within 80 meters of the main laboratory building at the Station and were from the shallow, sandy, friable soil overlying the gray sandstone characteristic of much of the top of Salt Pond Mountain on which the lake and the biological station are located. The soil has a high humus content and in most areas contains a tangle of roots and rootlets. Typical second-growth forest shading the sample sites includes oaks (chiefly *Quercus alba* and *Q. rubra*), maples (*Acer rubrum*, *A. pennsylvanicum*), yellow birch (*Betula alleghaniensis*) and black gum (*Nyssa sylvatica*); conifers are sparse in the

immediate area. Understory plants include saplings of these and of chestnut (*Castanea dentata*), as well as ericaceous shrubs (*Vaccinium*, *Gaylussacia*, and others). Ground-cover plants include ferns of several species, fly poison (*Amianthium muscaetoxicum*), dewberry (*Rubus villosus*), and a variety of others. Dates of sampling were between 11 and 16 June, when the course was taught in the first summer term, and 16 and 24 July when in the second term.

Over the years, two groups of arthropods, the Acarina (mites) and the Collembola (springtails), have dominated the census figures, as can be seen in Table 1 by comparing total sample counts with the totals for these groups. Although Collembola outnumbered Acarina in two-thirds of the samples, the Acarina show the greater numbers overall. Furthermore, the Acarina have consistently exhibited the greater diversity, always being represented by many different families.

Such non-hexapod taxa as Symphyla, centipedes, millipedes, pseudoscorpions, and micryphantid spiders have routinely been found. Of these, only the Symphyla were often present in considerable numbers (24 to 195 individuals; see Table 1), while the others were recovered in low numbers. Larval Coleoptera and Diptera (particularly Nematocera) were common, and immatures of Homoptera, Thysanoptera, Psocoptera, Lepidoptera and Mecoptera appeared from time to time. Samples usually contained a few ants and occasionally adult insects representing other orders. Small numbers of non-arthropod organisms were found in most samples; these included annelids (earthworms), nematodes (probably many of the extremely small ones were overlooked) and snails.

The most abundant hexapods in every sample have been the Collembola. For the purposes of an introductory course, we have recognized only four families: Hypogas-

¹Contribution no. 3106 from the Snow Entomological Museum & Department of Entomology, University of Kansas.

truridae (formerly Poduridae in the broad sense and possibly including some Onychiuridae) (11.4-62.3% of Collembola in a sample; mean 43.5%), Entomobryidae (including Isotomidae) (26.9-79.2%; mean 51.3%), Sminthuridae (1.5-12.2%; mean 5.2%) and Neelidae. Neelids were rare and present only in negligible numbers.

There have been some rather striking fluctuations in the number of Collembola recovered and simultaneously in the total number of arthropods collected. On 23 July 1971, both Collembola and Acarina reached their highest recorded numbers (Table 1), while in the corresponding sample two years later (20 July 1973), Acarina dropped to their lowest level and Collembola to their second lowest. Collembola were lowest in 1984 (sample taken on 16 July).

In 1965 and all subsequent years of sampling at Mountain Lake, I have continued to operate the Berlese funnel throughout the five-week course, often obtaining later samples quite near where earlier ones were taken. So much variation was seen from one of these samples to the next that it was evident the composition of the fauna was very much a matter of the particular site. That is, adjacent samples taken about a week apart could show considerably different faunal characteristics. Consequently, our infrequent samples cannot be relied upon to indicate widespread population levels or trends of change

over time (such as effects of acid rain). Numerous samples of random distribution within the area would be required to show these effects. I have not examined in any detail the ecological conditions from one sample site to the next. Neither am I sufficiently acquainted with the biological requirements of the many species of Collembola, Acarina, etc., to know what factors control their numbers or their spatial distribution. Such small, localized differences as presence or absence of a particular food source, more or less humid conditions, differences in soil chemistry, and microclimatic temperature differences possibly related to hours of shade or sun, or to thickness of the leaf-litter, come to mind. Seasonal variation in environmental conditions, such as between June and July samples, surely affects localized faunas, as well as population levels in general. What the samples indicate is that there has been no significant decline in the numbers of individuals of the dominant soil taxa over nearly 30 years (Table 1).

Acknowledgment

I would like to thank Dr. Christine A. Nalepa of North Carolina State University for reading a draft of this paper and making helpful suggestions.

Table 1. Numbers of representative arthropods in soil samples taken in years indicated at Mountain Lake Biological Station, Giles County, Virginia.

Year	Acarina	Collembola	Symphyla	Total, all taxa
1965	2758	3006	63	6171
1967	1553	2250	79	4294
1969	2715	1588	33	4874
1971	4886	5409	180	10895
1973	1082	1288	92	2968
1975	1866	1917	24	4873
1977	1091	1368	175	2998
1979	1238	1774	195	3451
1980	3332	1740	78	5328
1982	2804	1454	100	4685
1984	2960	1255	109	4557
1986	2602	2726	44	5746
1988	1906	1616	166	4164
1990	1329	1991	145	4413
1992	2768	3871	179	7070
	34890	33253	1662	76487